• No calculators are allowed on this exam.

• Please show all of your work. You may use backs of pages if necessary. You might not receive full credit for a correct answer if there is no work shown.

• You do not need to simplify all the way (but please evaluate trig functions when possible).

  Unacceptable answer: $4x^2 - x|_{1}^{2}$.
  Acceptable answer: $(4(2^2) - 2) - (4 - 1)$.

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<th>QUESTION</th>
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1. (20 pts) Compute the following.

(a) \[ \int_0^4 \frac{1}{\sqrt{3x + 4}} \, dx \]

(b) \[ \int \arctan(x) \, dx \]
2. (20 pts)

(a) Compute \( \int e^{\sin(x)} \cos(x) \, dx \)

(b) What is the average value of \( y = x \cos x \)

on the interval \([-\pi, \pi]\)?
3. (20 pts)

(a) Use Simpson’s rule with \( n = 4 \) to approximate
\[
\ln 5 = \int_{1}^{5} \frac{1}{x} \, dx.
\]

(b) Find a bound for the error of your estimate in part (a). (Recall that \( E_{n} \leq \frac{K(b-a)^{5}}{180n^{4}} \).)

(c) How large would \( n \) have to be in order to guarantee that \( S_n \approx \ln 5 \) is accurate to 5 decimal places? You do not need to simplify.
4. (20 pts) A solid is formed by rotating the shaded region around the $y$-axis.

![Diagram](image)

$x^2 + y^2 = 25$

(a) Express the volume of the solid as an integral using $dx$. Do not evaluate the integral.

(b) Express the volume of the solid as an integral using $dy$. Do not evaluate the integral.
5. **(20 pts)** A square well is 10m deep, and each of its four sides has length 2. The well is filled to a depth of 6m with water. Find the work done in pumping all of the water out of the well. (Recall that the density of water is 1000 kg/m³, and that the acceleration due to gravity is 9.8 m/sec².)